

WHAT IS CLAIMED IS:

1. A device adapted to transfer characteristics of a road departure warning installation installed on a road to a driver of a vehicle, comprising:
 - a rumble strip sensor adapted to sense input from a rumble strip; and
 - 5 an adjustable vehicle component in communication with the rumble strip sensor, the adjustable vehicle component being adapted to automatically adjust, in response to input into the rumble strip sensor from a rumble strip, to increase an amount of input from the rumble strip sensed by the driver.
- 10 2. The device of claim 1, wherein the component includes a hydraulic steering system control valve, and wherein the component is adapted to adjust the resonance frequency of the control valve to increase the amount of input from the rumble strip sensed by the driver.
- 15 3. The device of claim 1, wherein the component includes a steering wheel, and wherein the component is adapted to adjust the resonance frequency of the steering wheel to increase the amount of input from the rumble strip sensed by the driver.
4. The device of claim 1, wherein the component includes a vehicle body, and
20 wherein the component is adapted to adjust a resonance frequency of a body of the vehicle to increase the amount of input from the rumble strip sensed by the driver.
5. The device of claim 1, further comprising a steering wheel, wherein the component comprises a vibration transfer device adapted to transfer unsprung mass
25 vibration of a vehicle suspension generated by the rumble strip to a hydraulic power steering circuit, wherein the hydraulic power steering circuit is in communication with the steering wheel such that the vibration transferred to the hydraulic power steering circuit is transferred to the steering wheel to increase the amount of input from the rumble strip sensed by the driver.

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6. The device of claim 2, further comprising a steering wheel in communication with the control valve, wherein the component is adapted to adjust the resonance frequency of the control valve to substantially match unsprung mass vibration of a vehicle suspension generated by the rumble strip to increase hydraulic pulsation of hydraulic fluid in the control valve so that the steering wheel is vibrated to increase the amount of input from the rumble strip sensed by the driver.
7. A device adapted to transfer characteristics of a road departure warning installation installed on a road to a driver of a vehicle, comprising:
a rumble strip sensor adapted to sense input from a rumble strip; and
an adjustable vehicle suspension system in communication with the rumble strip sensor, the adjustable vehicle suspension system being adapted to automatically adjust in response to input into the rumble strip sensor from a rumble strip.
8. The device of claim 7, wherein automatic adjustment of the vehicle suspension system includes adjustment to increase the amount of input from the rumble strip sensed by the driver.
9. The device of claim 8, wherein the adjustable vehicle suspension system includes a shock absorber, and wherein adjustment to increase the amount of input from the rumble strip sensed by the driver includes an adjustment of a damping factor of the shock absorber.
10. The device of claim 9, wherein adjustment of the damping factor of the shock absorber in the vehicle suspension includes adjustment of the damping factor to an input frequency of a plurality of rumble strips sensed by the rumble strip sensor.
11. The device of claim 8, wherein the adjustable vehicle suspension system includes a suspension spring, and wherein adjustment to increase the amount of input from the rumble strip sensed by the driver includes an adjustment of a spring constant of the spring.

12. A device adapted to make a driver of vehicle aware of contact with a road departure warning installation installed on a road, comprising:

a rumble strip sensor adapted to sense input from a rumble strip; and

5 a vehicle component control device adapted to change a state of a vehicle component in communication with the vehicle component control device in response to input into the rumble strip sensor from a rumble strip.

13. The device according to claim 12, wherein the vehicle component is a visual
10 indicator inside the cabin of the vehicle that is activated in response to input into the rumble strip sensor from a rumble strip.

14. The device according to claim 12, wherein the vehicle component is a vibrator that is activated in response to input into the rumble strip sensor from a rumble strip.

15. The device according to claim 14, wherein the vibrator is in mechanical communication with at least one of a steering wheel, a driver's seat, and a gas pedal, and wherein the vibrator vibrates at least one of the respective steering wheel, driver's seat and gas pedal when activated.

20 16. The device according to claim 12, wherein the vehicle component is at least one of an automatically tightening driver's seat belt, a powered door window, and a powered door lock, wherein the component control device at least one of tightens the driver's seat belt, lowers or raises the powered door window and locks the powered
25 door lock, respectively.

17. The device according to claim 12, wherein the vehicle component is at least one of an aerosol dispenser with a nozzle mounted in the vehicle cabin, and wherein the component control device enables the aerosol dispenser to emit a fragrance.

30 18. The device according to claim 17, wherein the fragrance has a pungent smell

known to heighten an awareness of a typical human being.

19. A device adapted to determine whether a vehicle is deviating into an oncoming lane of an un-divided highway, comprising:

5 a processor adapted to receive at least a first signal indicative of contact of a rumble strip with a tire of the vehicle, wherein the processor includes logic to:

determine whether or not the vehicle is deviating into an oncoming lane; and

10 initiate a first warning to a driver of the vehicle once the processor has received the first signal and has determined that the vehicle is not deviating into an oncoming lane; and

initiate a second warning to a driver of the vehicle once the processor has received the first signal and has determined that the vehicle is deviating into an oncoming lane, wherein the first warning is different than the second warning.

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20. The device according to claim 19, wherein the device further includes:

a first warning device in communication with the processor, wherein the first warning device is adapted to issue the first warning to the driver; and

20 a second warning device in communication with the processor, wherein the second warning device is adapted to issue the second warning to the driver that is different than the first warning.

21. The device according to claim 19, wherein the device further includes:

25 a warning device in communication with the processor, wherein the warning device is adapted to issue the first warning to the driver and the second warning to the driver.

22. The device according to claim 21, wherein the first warning and the second warning comprise an audio message to the driver, the second warning being louder
30 than the first warning.

23. The device according to claim 19, wherein the processor utilizes information based on GPS data to estimate whether or not the vehicle is deviating into an oncoming lane.

5 24. The device according to claim 19, wherein the first signal is also indicative of a type of rumble strip in contact with the tire, and wherein the processor includes logic to analyze the first signal and estimate whether or not the vehicle is deviating into an oncoming lane based on the type of rumble strip in contact with the tire.

10 25. The device according to claim 19, wherein the first signal is also indicative of a frequency of contact with rumble strips and the tire, and wherein the processor includes logic to analyze the frequency of contact and, based on the frequency of contact, estimate whether or not the vehicle is deviating into an oncoming lane.

15 26. A device adapted to determine whether a vehicle is deviating into an oncoming lane of an un-divided highway, comprising:
a processor adapted to receive at least a first signal indicative of contact of a rumble strip with a tire of the vehicle, wherein the processor includes logic to:
determine that the vehicle is deviating into an oncoming lane; and
20 initiate a vehicle control command to at least one of automatically steer the vehicle away from the oncoming lane and automatically brake the vehicle once the processor has received the first signal and has determined that the vehicle is deviating into an oncoming lane.

25 27. The device according to claim 26, wherein the processor further includes logic to:
initiate a first warning to a driver of the vehicle once the processor has received the first signal and has determined that the vehicle is not deviating into an oncoming lane.

30 28. The device according to claim 26, wherein the device further includes:

a vehicle control unit in communication with the processor, wherein the vehicle control unit is adapted to receive the vehicle control command from the processor and to at least one of automatically steer the vehicle away from the oncoming lane and automatically brake the vehicle once the processor has received
5 the first signal and has determined that the vehicle is deviating into an oncoming lane.

29. The device according to claim 26, wherein the processor utilizes information based on GPS data to determine that the vehicle is deviating into an oncoming lane.

10 30. The device according to claim 26, wherein the first signal is also indicative of a type of rumble strip in contact with the tire, and wherein the processor includes logic to analyze the first signal and to determine that the vehicle is deviating into an oncoming lane based on the type of rumble strip in contact with the tire.

15 31. The device according to claim 26, wherein the first signal is also indicative of a frequency of contact between a plurality of rumble strips and the tire, and wherein the processor includes logic to analyze the frequency of contact and, based on the frequency of contact, determine that the vehicle is deviating into an oncoming lane.

20 32. A device adapted to alter the stability characteristics of a vehicle after the vehicle has come into contact with a road departure warning installation installed on a road with respect to the vehicle, comprising:

a processor adapted to receive at least a first signal indicative of contact of a rumble strip with a tire of the vehicle, wherein the processor includes logic to:

25 determine that the vehicle is deviating from a road based at least on the first signal; and

issue a command to change the state of a variable vehicle stability component or vehicle stability system once the processor has received the first signal and has determined that the vehicle is deviating from the road.

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33. The device according to claim 32, further comprising a variable vehicle

stability component or variable vehicle stability system in communication with the processor, wherein the variable vehicle stability component or stability system includes a vehicle suspension system, wherein the vehicle suspension system is automatically adjustable to increase the stability of the vehicle in response to the receipt of the command from the processor after the processor has determined that the vehicle is deviating from the road.

34. The device according to claim 33, wherein the vehicle suspension system includes a suspension spring or a shock absorber in communication with the processor, wherein a spring constant or a dampening factor of the suspension spring or the shock absorber, respectively, is automatically adjustable in response to the receipt of the command from the processor after the processor has determined that the vehicle is deviating from the road.

35. The device according to claim 32, further comprising a variable vehicle stability component or vehicle stability system, wherein the variable vehicle stability component or vehicle stability system includes a front-rear roll-rigidity proportion control unit, wherein the control unit is automatically adjustable to increase the stability of the vehicle in response to the receipt of the command from the processor after the processor has determined that the vehicle is deviating from the road.

36. The device according to claim 32, further comprising a variable vehicle stability component or vehicle stability system, wherein the vehicle stability component or vehicle stability system includes a device adapted to automatically lower the height of a vehicle in response to the receipt of the command from the processor after the processor has determined that the vehicle is deviating from the road.

37. The device according to claim 32, further comprising a variable vehicle stability component or vehicle stability system, wherein the vehicle stability component or vehicle stability system includes an automatic variable steering gear

ratio control unit adapted to automatically vary the steering gear ratio in response to the receipt of the command from the processor after the processor has determined that the vehicle is deviating from the road.

5 38. The device according to claim 30, wherein the processor utilizes information based on GPS data to determine that the vehicle is deviating into an oncoming lane.

39. A device adapted to determine the distance between a lane marker and a rumble strip, comprising:

10 a processor adapted to:
 receive a first signal indicative of the crossing of a lane marker by a vehicle;
 receive a second signal indicative of a lateral speed of the vehicle;
 receive a third signal indicative of contact of a rumble strip with a tire
 15 of the vehicle;
 analyze the third signal and determine that the rumble strip has contacted the tire;
 determine the time period between receiving the first signal and receiving the third signal; and
 20 determine the distance between the lane marker and the rumble strip based on the time period between receiving the first signal and receiving the third signal and the lateral speed of the vehicle.

40. The device according to claim 39, wherein the distance (W_{ln-rs}) between the
 25 lane marker and the rumble strip is determined based on the equation:

$$W_{ln-rs} = V_{ltrl} \cdot \Delta t_{ln-rs}$$

where,

V_{ltrl} = lateral speed of the vehicle, and

Δt_{ln-rs} = time between crossing the lane marker and
 30 detecting the rumble strip.

41. The device according to claim 39, further comprising a sensor adapted to detect the lane marker and determine that the vehicle has crossed the lane marker.

42. A device adapted to alter vehicle stability in the event of road departure,
5 comprising:
a processor adapted to:
receive a signal indicative of contact of a rumble strip with a tire of the
vehicle;
analyze the received signal and determine whether the rumble strip has
10 contacted the tire;
receive input relating to the distance of the rumble strip with respect to
a lane marker;
analyze the received input and determine the distance between the
rumble strip and the lane marker; wherein the processor includes logic to:
15 issue a command to change the state of a variable vehicle stability
component or vehicle stability system once the processor has determined that the
vehicle is in contact with the rumble strip, wherein a degree by which the state of the
variable vehicle stability component or vehicle stability system is changed is
determined by the distance between the rumble strip and the lane marker.

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43. The device according to claim 42, wherein the degree by which the state of the
variable vehicle stability component or vehicle stability system is commanded to
change is greater the greater the distance between the rumble strip and the lane
marker.

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44. The device according to claim 42, wherein the degree by which the state of the
variable vehicle stability component or vehicle stability system is commanded to
change is greater the greater the distance between the rumble strip and the lane marker
until the distance between the rumble strip and the lane marker is about equal to the
30 tread width of the vehicle.

45. The device according to claim 42, wherein the degree by which the state of the variable vehicle stability component or vehicle stability system is commanded to change is greater the greater the distance between the rumble strip and the lane marker until the distance between the rumble strip and the lane marker is about equal to the tread width of the vehicle, after which the state of the variable vehicle stability component or vehicle stability system is not commanded to change.

46. A device adapted to alter vehicle stability in the event of road departure, comprising:

10 a processor adapted to:

receive a signal indicative of contact of a rumble strip with a tire of the vehicle;

analyze the received signal and determine that the rumble strip has contacted the tire;

15 receive input relating to the distance of the rumble strip with respect to a lane marker;

analyze the received input and determine the distance between the rumble strip and the lane marker; wherein the processor includes logic to:

20 initiate a vehicle control command to at least one of automatically steer the vehicle away from the rumble strip and automatically brake the vehicle once the processor has determined that the vehicle is in contact with the rumble strip, wherein a degree by which the vehicle is steered away from the rumble strip and automatically braked is determined by the distance between the rumble strip and the lane marker.

25 47. The device according to claim 46, wherein the degree by which the vehicle is commanded to steer away from the rumble strip and automatically brake is greater the greater the distance between the rumble strip and the lane marker.

30 48. The device according to claim 46, wherein the degree by which the vehicle is commanded to steer away from the rumble strip and automatically brake is greater the greater the distance between the rumble strip and the lane marker until the distance

between the rumble strip and the lane marker is about equal to the tread width of the vehicle.

49. The device according to claim 46, wherein the degree by which the vehicle is
5 commanded to steer away from the rumble strip and automatically brake is greater the
greater the distance between the rumble strip and the lane marker until the distance
between the rumble strip and the lane marker is about equal to the tread width of the
vehicle, after which the degree by which vehicle is steered away from the rumble strip
and automatically braked is not changed.

10 50. A device adapted to make a driver of vehicle aware of vehicle contact with a
road departure warning installation installed on a road, comprising:

a processor adapted to:

15 receive a signal indicative of contact of a rumble strip with a tire of the
vehicle;

analyze the received signal and determine that the rumble strip has
contacted the tire;

20 issue a first command to a vehicle component control device to change
the state of a vehicle component after determining that the rumble strip has contacted
the tire; and

determine that the vehicle has traveled substantially further in the
lateral direction beyond the contacted rumble strip after the vehicle has contacted the
rumble strip and issue a second command to the vehicle component control device
separate from the first command to change the state of a vehicle component after
25 determining that the vehicle has traveled substantially further in the lateral direction.

51. The device according to claim 50, wherein the first command to the vehicle
component control device is to momentarily tighten a driver's seatbelt and then to
relax the driver's seatbelt, and wherein the second command to the vehicle component
30 control device is to tighten the driver's seatbelt and maintain the seatbelt tightened for
a substantial period of time.

52. The device according to claim 50, wherein the processor includes logic to:
determine that the vehicle has traveled substantially further in the lateral
direction beyond the contacted rumble strip based on a lateral speed of the vehicle
5 with respect to the rumble strip; wherein
the first command to the vehicle component control device is to momentarily
tighten a driver's seatbelt and then to relax the driver's seatbelt, and wherein the
second command to the vehicle component control device is to tighten the driver's
seatbelt and maintain the seatbelt tightened for a substantial period of time.
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53. The device according to claim 50, wherein the processor includes logic to:
determine that the vehicle has traveled substantially further in the lateral
direction beyond the contacted rumble strip based on a lateral speed of the vehicle
with respect to the rumble strip; and
15 override the issuance of the second command if the lateral speed of the vehicle
with respect to the rumble strip is greater than a predetermined speed; wherein
the first command to the vehicle component control device is to tighten at least
one of a driver's seatbelt and a passenger's seatbelt.
- 20 54. The device according to claim 50, wherein the first command to the vehicle
component control device is to open a driver's side window, and wherein the second
command to the vehicle component control device is to close the driver's side
window and maintain the window closed for a substantial period of time.
- 25 55. The device according to claim 50, wherein the processor includes logic to:
determine that the vehicle has traveled substantially further in the lateral
direction beyond the contacted rumble strip based on a lateral speed of the vehicle
with respect to the rumble strip; wherein
the first command to the vehicle component control device is to open a
30 driver's side window, and wherein the second command to the vehicle component
control device is to close the driver's side window and maintain the window closed

for a substantial period of time.

56. The device according to claim 50, wherein the processor includes logic to:
determine that the vehicle has traveled substantially further in the lateral
5 direction beyond the contacted rumble strip based on a lateral speed of the vehicle
with respect to the rumble strip; and
override the issuance of the second command if the lateral speed of the vehicle
with respect to the rumble strip is greater than a predetermined speed; wherein
the first command to the vehicle component control device is to close at least
10 one of a driver's window and a passenger's window.

57. The device according to claim 50, wherein the first command to the vehicle
component control device is to increase and then decrease the dampening factors of at
least one vehicle shock absorber, and wherein the second command to the vehicle
15 component control device is to increase the dampening factor of all of the vehicle
shock absorbers and maintain them increased for a substantial period of time.

58. The device according to claim 50, wherein the processor includes logic to:
determine that the vehicle has traveled substantially further in the lateral
20 direction beyond the contacted rumble strip based on a lateral speed of the vehicle
with respect to the rumble strip; wherein
the first command to the vehicle component control device is to increase and
then decrease the dampening factors of at least one vehicle shock absorber, and
wherein the second command to the vehicle component control device is to increase
25 the dampening factor of all of the vehicle shock absorbers and maintain them
increased for a substantial period of time.

59. The device according to claim 50, wherein the processor includes logic to:
determine that the vehicle has traveled substantially further in the lateral
30 direction beyond the contacted rumble strip based on a lateral speed of the vehicle
with respect to the rumble strip; and

override the issuance of the second command if the lateral speed of the vehicle with respect to the rumble strip is greater than a predetermined speed; wherein

the first command to the vehicle component control device is to increase the dampening factor of all of the vehicle shock absorbers and maintain them increased
5 for a substantial period of time.

60. The device according to claim 50, wherein the first command to the vehicle component control device is to increase a front roll rigidity ratio of the vehicle, and wherein the second command to the vehicle component control device is to increase
10 the dampening factor of all of a vehicle's shock absorbers and maintain them increased for a substantial period of time.

61. The device according to claim 50, wherein the first command to the vehicle component control device is to increase a dampening factor on front shock absorbers
15 of the vehicle and decrease a dampening factor on rear shock absorbers, and wherein the second command to the vehicle component control device is to increase the dampening factor on the rear shock absorbers to about the dampening factor on the front shock absorbers.

20 62. The device according to claim 50, wherein the processor includes logic to: determine that the vehicle has traveled substantially further in the lateral direction beyond the contacted rumble strip based on a lateral speed of the vehicle with respect to the rumble strip; wherein
the first command to the vehicle component control device is to increase a
25 dampening factor on front shock absorbers of the vehicle and decrease a dampening factor on rear shock absorbers, and wherein the second command to the vehicle component control device is to increase the dampening factor on the rear shock absorbers to about the dampening factor on the front shock absorbers.

30 63. The device according to claim 50, wherein the first command to the vehicle component control device is to decrease a steering gear ratio of a steering gear ratio

control system, and wherein the second command to the vehicle component control device is to increase a dampening factor of all of a vehicle's shock absorbers and maintain them increased for a substantial period of time.

5 64. The device according to claim 50, wherein the processor includes logic to:
 determine that the vehicle has traveled substantially further in the lateral
 direction beyond the contacted rumble strip based on a lateral speed of the vehicle
 with respect to the rumble strip; wherein
 the first command to the vehicle component control device is to decrease a
10 steering gear ratio of a steering gear ratio control system, and wherein the second
 command to the vehicle component control device is to increase the dampening factor
 of all of a vehicle's shock absorbers and maintain them increased for a substantial
 period of time.

15 65. The device according to claim 50, wherein the first command to the vehicle
 component control device is to reduce the vehicle height by a predetermined amount,
 and wherein the second command to the vehicle component control device is reduce
 the vehicle height so that the vehicle height is lower than the vehicle height resulting
 from the first command.

20 66. The device according to claim 65, wherein the second command to the vehicle
 component control device is reduce the vehicle height so that the vehicle height is as
 low as possible.

25 67. The device according to claim 50, wherein the processor includes logic to:
 determine that the vehicle has traveled substantially further in the lateral
 direction beyond the contacted rumble strip based on a lateral speed of the vehicle
 with respect to the rumble strip; wherein
 the first command to the vehicle component control device is to reduce the
30 vehicle height by a predetermined amount, and wherein the second command to the
 vehicle component control device is reduce the vehicle height so that the vehicle

height is lower than the vehicle height resulting from the first command.

68. The device according to claim 50, wherein the processor includes logic to:
determine that the vehicle has traveled substantially further in the lateral
5 direction beyond the contacted rumble strip based on a lateral speed of the vehicle
with respect to the rumble strip; and
override the issuance of the second command if the lateral speed of the vehicle
with respect to the rumble strip is greater than a predetermined speed; wherein
the first command to the vehicle component control device is to reduce the
10 vehicle height so that the vehicle height is as low as possible.